DOCUMENT RESUME

ED 147 469 08 CE 012 965

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TITLE Nuclear Medical Technology. Curriculum for a Two Year Program. Final Report.
INSTITUTION Middlesex Community Coll., Middletown, Conn.
SPONS AGENCY Bureau of Occupational and Adult Education (DHEW/OE), Washington, D.C.; Connecticut Vocational Education Research and Planning Unit, Hartford.
PUB DATE Jun 77
NOTE 52p.; Parts of appendixes may be marginally legible due to pr int quality of the document

EDRS PRICE MF-$0.83 HC-$3.50 Plus Postage.
DESCRIPTORS Associate Degrees; Community Colleges; *Cooperative Programs; *Core Curriculum; Course Descriptions; Curriculum Design; *Curriculum Development; *Health Occupations Education; Hospital Personnel; Hospitals; Interinstitutional Cooperation; *Medical Technologists; Paraprofessional Personnel; Post Secondary Education; *Radiologic Technologists

ABSTRACT

Objectives of the project briefly described here were (1) to develop curriculum for a two-year nuclear medical technology program based on a working relationship between three institutions (community college, university health center, and hospital) and (2) to develop procedures for the operation of a medical imaging and radiation technology core program for radiologic, nuclear medicine, ultrasound, radiotherapy, and biomedical technology. Methods used in the interinstitutional cooperative curriculum development effort are summarized, followed by a general description of the curriculum, a curriculum outline, and brief descriptions of the courses. A time schedule for students and an outline of student hours are presented. Twenty pages of instructional objectives for each course are provided, followed by recommended texts, laboratory manuals, and references. A general description of the medical imaging and radiation technology core program is included, along with an explanation of the cooperative relationship of the core program with the community college and hospitals. Conclusions and recommendations regarding the cooperative curriculum development effort are presented, followed by a bibliography. Essentials of an Accredited Educational Program for the Nuclear Medical Technologist are appended. An outline of Naval training programs for nuclear medicine technician, x-ray technician, x-ray technique, clinical nuclear medicine technician, and radioactive isotope technician is also appended. (BL)

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ED147469

NUCLEAR MEDICAL TECHNOLOGY

CURRICULUM FOR A TWO YEAR PROGRAM

FINAL REPORT

BEST COPY AVAILABLE

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CE 012 965

CONNECTICUT STATE DEPARTMENT OF EDUCATION
DIVISION OF VOCATIONAL EDUCATION
RESEARCH AND PLANNING UNIT
HARTFORD, CONNECTICUT

PREFACE

This curriculum study was made possible by a research grant from the Connecticut State Department of Education, Division of Vocational Education, Research and Planning Unit. The study was performed under the purview of Dr. Frederick L. Haddad, Consultant, Research and Planning Unit whom we wish to thank for his guidance and his assistance.

This work is a result of the foresight and the impetus of Dr. Richard Spencer, Professor and Head of Nuclear Medicine at the University of Connecticut Health Center who more than two years ago undertook to establish an educational training program in nuclear medical technology. Dr. John Sziklas, Director of Clinical Nuclear Medicine, Hartford Hospital worked with Dr. Spencer and with the authors to establish a relationship that could offer students a two year training program in nuclear medical technology as a cooperative effort between three institutions; The UConn Health Center, Hartford Hospital, and Middlesex Community College.

The College will administer this program as a specialty under a Medical Imaging and Radiation Technology Degreed program which will encompass several imaging modalities for diagnosis and the application of radiation for therapy. The MIRT program will be a core from which students, in their second year, will elect to specialize in any one of the options.

The practice of nuclear medicine includes the utilization of radioactive materials for therapeutic and diagnostic, "in-vivo" and"in-vitro" procedures and any combination thereof. The skills of the nuclear medical technologist shall complement those of the nuclear medicine physician and other professionals in the field. The nuclear medicine technologist must be able to perform effectively in three major areas of responsibility: 1)patient care, 2)technical skills, and 3)administrative functions. (Reference 1).

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SUMMARY

This report contains the curriculum materials for a two year training program in nuclear medical technology. The materials were written based on a working relationship between three institutions which could offer the student the academic training for the first year of study (Middlesex Community College), and the didactic training (The University of Conn. Health Center) and clinical training (Hartford Hospital) during the second year of study. In addition, the student will earn an Associate in Science degree from the college, and he will be qualified and permitted to sit for the Registry examination.

The training program in nuclear medical technology will be a specialty of a Medical Imaging and Radiation Technology program which will be administered by the Community College. The MIRT program will contain a core of basic courses which all students will be required to take while at the college. During their second year they will specialize in any one of the options in the imaging modalities or in the application of radiation for therapy. This program will also provide upward mobility for radiologic technologists who wish to become certified in nuclear medical technology.

The objectives of this study were to develop the curriculum for the NMT training program, and to develop the procedures for the operation of the MIRT core program. The first objective was completed in detail, and an operating framework was developed for the second objective.

Much of the research work completed for the project consisted of literature searches in the academic and medical libraries at several colleges and hospitals in the central Connecticut area. In addition, both authors interviewed and discussed with many professionals working in Connecticut and in New England. Those professionals included physicians, physicists, researchers, technologists, hospital administrators, and college faculty and administrators. It was deemed of first importance to gather the information from and the opinions of professionals currently working in the field.

Based on the experience of producing these materials and the experiences of other programs operating as cooperative efforts between colleges and hospitals, it is believed that such programs are not only beneficial for students, but necessary. Neither colleges nor hospitals can afford to offer to students a complete range of academic and clinical experiences, and all agree that students should have both of these experiences. Each organization has what the other needs, and cooperative efforts will be more efficient than unnecessary duplication. In nuclear medical technology this is especially true due to the extensive use of and the training required for large scale, complex, and very expensive medical electronic equipment.

The expansion of the cooperative efforts to include affiliations with more than one hospital in an effort to serve other related fields such as radiologic technology, ultrasound, and radiotherapy is a logical expansion of this concept and will add the dimension of flexibility and rotation. Although the operation of such a program will be more cumbersome due to the number of cooperating institutions involved, it is believed to be overall more efficient from the standpoint of sharing facilities and services, and will increase communications and cooperation in this field.

BACKGROUND

Dr. Richard Spencer, Professor Head of Nuclear Medicine at the University of Connecticut Health Center intiated the work on a program in nuclear medical technology to be affiliated with a large community hospital (Hartford Hospital) and a community college (Middlesex). Survey conducted by his staff in Connecticut during the latter part of 1975 indicated that there was a need to train more technologists than were available. Studies produced by the Conn. Institute for Health Manpower Resources, in that same year, indicated (Reference 2) that there was a need for additional technologists and training programs in this field in Connecticut. Reference3 indicated that there were only about twelve two year Associate in Science Degreed programs nationwide and that the move to increase hospital and community college affiliations was increasing.

This information in addition to that supplied by the Society of Nuclear Medicine confirmed the need to establish such a program in Connecticut. This program would be established in addition to and in cooperation with an existing program at Yale/ New Haven hospital in which Dr. Spencer was instrumental in establishing while he was there.

Dr. John Sziklas, Director of Clinical Nuclear Medicine at Hartford Hospital and the authors joined with Dr. Spencer in working on the establishment of a program. The curriculum materials written were based not only on the technocal aspects of the field, but also on this three way cooperation between institutions. It was the intent of the initiators to produce this program with existing staff, equipment, and facilities. To that end the curriculum materials were designed based on the current services of each institution. The behavioral objectives for students in nuclear medical technology are set down in Appendix B, and it was the job of this study to organize and define currently existing services in each organization in such a way as to meet the requirements of the Essentials, the Community College, the Health Center, and the Community Hospital.

The staff at the UConn Health Center was committed to suppling the didactic work, the staff at Hartford Hospital the clinical work, and the staff at Middlesex Community College the academic work. In addition, it was the college's intention to establish the NMT program as a model option under a core program in Medical Imaging and Radiation Technology around which it could cluster an existing program in Radiologic Technology, and new programs to be developed such as ultrasound, radiotherapy, and biomedical technology. The academic offerings in the first year are general rather than specific in order to cover the materials required by students specializing in several imaging fields as well as radiotherapy. Specialization is accomplished during the second year in the clinical phase.

METHODS

The methods used in establishing the materials consisted of searching, defining, and organizing the services, personnel, and facilities at all three institutions which would be involved in the operation of this program. The search was accomplished simply by contacting staff members in the organizations who belonged to departments whose involvement was obvious. All contacts were cordially received often with enthusiasm and very seldom with reluctance which was caused by the fear that students would interfere with the work and the efficiency of a department.

Literature searches were performed at the libraries of area colleges and hospitals and with the cordial assistance of the staff of the Society of Nuclear Medicine. Existing programs were investigated, not only for the two year A.S. degree type, but also the one year hospital based program, four year B.S. degree programs, and specialized upper division programs in the Radiologic Sciences. Assistance with this last catagory was offered by Scott Gregory and Eleanora Coates of the Department of Radiologic Sciences, Quinnipiac College.

The requirements of the AMA and the professional societies and registries were searched as well as the educational requiremen established by the Conn. Commission for Higher Education. Interviews and discussions were held with many working professiona either at their hospitals or at monthly grand rounds or at Society meetings in Connecticut and in New England. Also, manufacturers and suppliers were contacted to obtain company educational or promotional materials in attempts to document existing equipment and supplies currently in use and those in the research and testing stages. Discussions with hospital and college staff members involved in similar or related programs were held to unearth the difficulties in hospital-college programs.

Letters were sent to magazine and text book publishers and to professional societies requesting lists of books and documents which were later purchased. Much of the technical material was based on these references in addition to the discussions held with working professionals. The latter group contributed tremendously in the area of procedures and student handling and familiarization, and in the areas where various organizations might conflict.

All of the materials were compiled and organized, and then presented for review by the staff members of the three organizatio The science department and the professional staff approved the program as did the Board of Trustees for the Connecticut Community Colleges. The department heads at the Health Center and at Hartford Hospital also approved the technical content and the procedural aspects of the program.

In regard to the actual operation of the program, this is not yet possible since it must lastly be approved for licensure by the Commission for Higher Education and the AMA's Council on Medical Education.

GENERAL DESCRIPTION OF THE CURRICULUM

This curriculum will require 27 months to complete and starts in June of one year and is completed in September two years later. Students will attend classes at the Community College during their first year of study and during the summers preceding and following that year. The next year is spent essentialy full time in the clinical setting at the Community Hospital; however, they will spend one morning per week at the Health Center for their didactic work.

The program requires more than twentyfive hundred hours to be spent in the academic and clinical settings during the twentyseven month extent of the program. More than eighteen hundred hours of that time are spent during the second year in the clinical setting.

Students in their first year of study take basic courses in mathematics and science, and in psychology and sociology. Two elective courses at the college during the second summer offer the students an opportunity to broaden their liberal education, or to further pursue the sciences, or to make up work not completed during their first year. The summer courses during the second summer also add to the exposure that students have to the hospital setting prior to their full time involvement. They also take a course in hospital orientation which meets one friday morning per month during the academic year, and one friday morning for six weeks during the summer preceding the second year in the clinical phase of training. The last three months of the program include full time performance in the clinical area in preparation for the Registry examination.

The academic courses in the first year offer a basic foundation general enough to satisfy the needs of students in the related options of radiologic technology, ultrasound, radiotherapy, and, perhaps, biomedical technology. Of course, the work in the second year is very specific and demands the specialized behavioral objectives pertinent to each field. Students in other options will go to other departments or hospitals for their training.

A course pattern for the nuclear medical technology options is presented, and, for each course there is given a brief course description, instructional objectives designed to satisfy the behavioral objectives stated in the Essentials, and a list of recommended texts, lab manuals, and references. Also, a students schedule and hours are given.

COURSE PATTERN

MEDICAL IMAGING AND RADIATION TECHNOLOGY PROGRAM
(Nuclear Medical Technology)

(June) 1st Summer: (MxCC)

Eng. 101	3 Cr	
*Math 105	3 Cr	6 Cr

(Sept) 1st Year: (MxCC)

Fall		Spring		
Bio 103	4 Cr	Bio 104	4 Cr	
Chem 103	3	Chem 104	3	
Physics 103	3	Physics 104	3	
*Psych 100	3	*Soc 100	3	
Hosp. Orient.	0	Hosp. Orient.	0	
	13		13	26 Cr

(June) 2nd Summer: (MxCC)

Elective	3 Cr	
Elective	3	
Hosp. Orient.	0	
	6	6 Cr

(Sept) 2nd Year: (Hospital)

Fall		Spring		
Nuc. Med. Tech 101	3 Cr	NMT 105	3 Cr	
NMT 102	3	NMT 106	3	
NMT 103	3	NMT 107	3	
NMT 104	3	NMT 108	3	
	12		12	24 Cr

(June - Sept) 3rd Summer: (Hospital)

NMT 109	3 Cr	
NMT 110	3	
	6	6 Cr

TOTAL: 68 Cr.

*Minimum requirements

BRIEF COURSE DESCRIPTIONS*
(Offered at Middlesex Community College)

English 101 Basic Composition 3 Credits
Practice and analysis of techniques used in exposition. Emphasis on the fundamentals of sentences and paragraphs. Prerequisite: satisfactory placement scores, completion of English 99, or permission.

Math 105 Applied Mathematics I 3 Credits
Topics in arithmetic, algegra, and coordinate geometry. Emphasis on applying concepts to such subjects as marketing, computers, and sciences.

Biology 103 - 104 Anatomy-Physiology 4-4 Credits
The structural organization and functioning of the human body. Laboratory work includes comprehensive study of the cell, tissues, skeletal and muscular systems, blood cell morphology, and internal anatomy.

Chemistry 103 - 104 Introductory Chemistry 3-3 Credits
Recommended for students with minimal chemistry or mathematics background. A concise introduction to the fundamental concepts of chemistry which covers a broad range of topics: nomenclature, measurement, bonding, stoichiometry, equilibrium, organic chemistry, and biochemistry. Lab activities included.

Physics 103 - 104 Physics for the Medical Sciences 3-3 Credits
A survey of the introductory concepts of physics with emphasis on applications to the medical sciences. Lab activities and lectures at area hospitals included. Course approved by MxCC. Not yet listed in catalog.

Psychology 100 Selected Issues 3 Credits
Selected contemporary issues in psychology--for example, personality, motivation, learning, and drugs. Recommended for students who do not intend a baccalaureate major in the behavioral sciences.

Sociology 100 Introduction to Sociology: Contemporary Social Problems 3 Credits
A systematic analysis of major contemporary social problems, such as mental illness, crime, poverty, and racial and ethnic conflicts, with emphasis on their origins.

*Printed in the 1976-78 Middlesex Community College Catalog.

BRIEF COURSE DESCRIPTIONS
(Offered at the University of Connecticut
Health Center and Hartford Hospital)

Hospital Orientation

An introduction to the hospital setting and to the field of medical imaging. Students will observe in the working areas, and will attend lectures on ethics, patient care, emergency procedures, and medical imaging procedures.

Nuclear Medical Technology 101 - 102 Introduction to Radiophysics and Radiobiology 3-3 Credits

A survey of the basic concepts and definitions of radiation physics and radiobiology, and the interactions of radiation with matter are presented. Radiation safety, the management and handling of radioactive materials, and hospital and governmental regulations are covered. In the clinical setting, a review of terminology, ethics, and radiation protection are covered as well as observation and assisting in clinical procedures.

Nuclear Medical Technology 103 - 104 Introduction to Radiation Detection and Radio Pharmacy 3-3 Credits

A survey of radiation detectors, dose calibrators and nuclear medical instrumentation to include their use and their principles of operation. An introduction to the preparation and utilization of radiopharmaceuticals. In the clinical setting, hands-on experience with detectors and survey equipment, and observation of the use of radiopharmaceuticals and nuclear medical instrumentation.

Nuclear Med. 105 - 106 Clinical Nuclear Medicine and Nursing Procedures I 3-3 Credits

A study of the use and detection of radioactive materials *in vivo*. Includes the anatomical, physiological, and radiopharmaceutical aspects of *in vivo* diagnostic examinations. Particular attention is paid to techniques and nursing procedures.

Nuclear Med. 107 - 108 Clinical Nuclear Medicine and Nursing Procedures II 3-3 Credits

A study of the use and detection of radioactive materials *in vitro*. Includes competitive binding studies, and the physical and chemical principles of radioimmunoassay. A continuation of the study of nursing procedures.

Nuclear Med. 109 - 110 Clinical Nuclear Medicine Practicum 3-3 Credits

A practicum laboratory course in the use and detection of radioactive materials in the *in vivo* and *in vitro* phases designed to prepare the student for the Registry exam.

TIME SCHEDULE FOR STUDENTS

1st Year--at Middlesex Community College

Summer: Course work at Middlesex.

Fall: Course work at Middlesex primarily. A non-credit hospital orientation course. One Friday morning per month at Hartford Hospital or U.Conn. Health Center for tours and general introduction.

Spring: Same as fall, except that Friday mornings at U.Conn should include didactic work in health physics and radiation protection.

Summer: Two courses at the college. One Hospital Orientation course will include Friday mornings each week for six weeks. (About the middle of June to the end of July.)

Student Vacations:
Christmas--three weeks--Christmas to middle of January.
Spring--three weeks--Middle of May to middle of June.
Summer--three weeks--Last three weeks in August.

2nd Year--Clinical Phase at Hartford Hospital and U.Conn. Health Center - 12 Month Program

Fall and Spring: Full time clinical work at Hartford
(18wks) (18wks) Hospital plus one Friday morning per week at U.Conn. Health Center. Courses to be completed are NMT 101 thru 108.

Summer: Full time clinical work at Hartford Hospital; June to September. Courses to be completed are NMT 109 and 110.

Vacations--one week at Christmas; one week in May
Holidays--Five days observed by Hartford Hospital
Sick Days--Eight days allowed. Fifteen days maximum

Rotations:

In-Vivo Labs	6 months (one month each instrument)
In-Vitro Labs	3 months (two students at a time)
Research Rotation(UConn)	2 months (two students at a time)
Vacations, Holidays, Sick days	1 month

STUDENT HOURS

		Lecture	Lab.	Practicum
1st Summer-MxCC				
Eng 101	3Cr	6wksX8hr.		
Math 105	3	6 X 8		
		96hr.	0	0
1st Year-Fall-MxCC				
Bio 103	4 Cr	16wksX3hr.	16X2	
Chem 103	3	16 X 3	16X1	
Phys 103	3	16 X 3	16X1	
Psych 100	3	16 X 3		
*+Hosp. O.	0			(4 visitsX4hr)
		192 hr.	64 hr.	16 hr.
1st Year-Spring-MxCC				
Bio 104	4 Cr	16 X 3	16X2	
Chem 104	3	16 X 3	16X1	
Phy 104	3	16 X 3	16X1	
Soc 100	3	16 X 3		
*+Hosp. O.	0			(4 visitsX4hr)
		192 hr	64 hr	16 hr.
2nd Year-Summer-MxCC				
Elective	3 Cr	6wksX8hr.		
Elective	3	6 X 8		
*+Hosp. O.				(6 visitsX4hr)
		96 hr	0	24 hr.
2nd Year-Fall-Hospital		Didactic	Clinical	
NMT 101	3 Cr	18wksX1hr.*	18 X 8	
NMT 102	3	18 X 1	18 X 8	
NMT 103	3	18 X 1	18 X 8	
NMT 104	3	18 X 1	18 X 8	
		72 hr.	576 hr.	
2nd Year-Spring-Hospital				
NMT 105	3 Cr	18wksX1hr.*	18 X 8	
NMT 106	3	18 X 1	18 X 8	
NMT 107	3	18 X 1	18 X 8	
NMT 108	3	18 X 1	18 X 8	
		72 hr.	576 hr.	
3rh Summer-Hospital				
NMT 109			12wksX20hr.	
NMT 110			12wksX20hr.	
			480 hr.	

College Hours Totals	Lecture	+	Lab.	+	Practicum
	576 hrs.	+	128		0 = 704hours

Hospital Hours Totals	Didactic		Clinical	
	200 hrs.	+	1632 hrs	= 1832hours
Minimum hospital hours (minus twenty sick days and holidays)				= 1672hours
Grand Totals				2536hours

*Hospital lectures to be given every Friday morning at the UConn Health Center.

+Hours credited towards didactic work

INSTRUCTIONAL OBJECTIVES IN MATHEMATICS

A. Arithmetic - Review of addition, subtraction, multiplication and division of whole numbers, fractions, mixed numbers, and decimals. Determination of percents and ratios.

B. Algebra - Addition, subtraction, multiplication, and division of monomials. Solutions of algebraic equations and operations with exponential numbers. Application of algebraic expressions.

C. Significant Figures - The rules for rounding off. The danger of rounding off.

D. Scientific Notation - The metric system and the power of ten. Conversion of whole numbers, fractions, and decimals to scientific notation. Arithmetic and algebraic operations with numbers given in scientific notation.

E. Logarithms - Operations in common and natural logarithms to include multiplication, division, and exponentiation. Applications of logarithms.

F. Geometry - Review of basic concepts in geometry and application of principles to problems.

G. Trigonometry - Operations with trigonometric functions and the use of tables. Application of trig functions.

H. Graphing - Construction, application, and analysis of graphs for linear and exponential functions.

I. Slide Rule - Operation of the slide rule for multiplication, division, proportions, and exponents.

J. Pocket Calculators - Operation of calculators for arithmetic, algebraic, trignometric, and logarithmic problems.

K. Computers - Introduction to computers and data processing. Operation of basic programs.

INSTRUCTIONAL OBJECTIVES IN ENGLISH

A. Purpose of Communications - Primarily for exposition, but to include inquiry, information, and persuasion.

B. Methods of Communications - Primarily written, but to include oral and visual communications.

C. Written Communications - Of a formal and informal nature encompassing articles, memos, letters, and reports. Emphasis on grammar, organization, and style of the various forms of written communications

D. Oral and Visual Communications - Based on improvement of delivery on a person to person level, primarily and on a person to group level, secondarily.

E. Library use - To cover classification systems, references, periodicals, publications, and research work.

F. Survey of Reading Skills - To include analysis of written communications. Intensive reading plus techniques for skimming and scanning.

G. Survey of Writing - Technical reports written in the scientific style, and writing in the third person past tense. Importance of accuracy and honesty in the observation and recording of technical data.

H. Review of Various Materials - Reports, articles, and journals in the scientific and medical fields.

INSTRUCTIONAL OBJECTIVES IN PHYSICS

A. The Scientific Method - Measurements, accuracy, precision, significant figures, and methods.

B. Mathematics Review - Algebra, trigonometry, geometry, logarithms, graphing, scientific notation, the metric system, and conversion of units.

C. Motion - Equations of motion and graphs. Concepts of mass, weight, density, gravity, equilibrium, friction, and torques. Clinical applications of forces, motion, and torque.

D. Energy and Work - Principles of conservation, equations for work, energy and momentum. Calculations for problems applied to simple machines and analogies in the human body.

E. States of Matter - Gases, liquids, and solids. Atomic and molecular structures and laws governing the states. Problems applied to fluids in the body in the respiratory and circulatory systems.

F. Temperature and Heat - Definitions of temperature, heat, specific heat, heat of reaction, temperature scales, and units. Calculations to include determination of temperatures and conversion of units, and the determinations of heat quantities. Problems applied to the physiological implications of heat transfer.

G. Electricity and Magnetism - Introduction to the electrical nature of matter, electric charge and flow, definition of units, calculations, and instruments and machines. Problems and examples applied to bioelectricity in the human body and its measurement.

H. Electrical Circuits and Instruments - Definitions of the calculations for voltage, current, resistance, energy and power. Basic components; resistors, capacitors, inductors, transformers, etc. Survey of basic instrument amplifiers, computers, display devices, etc. Examples of medical instruments such as EKG, EEG, EMG, and x-ray, ultrasound and gamma detectors.

I. Sound and
Wave Motion - Definitions of elasticity, periodic motion, transverse and longitudinal waves, doppler effect, and interference. Examples applied to the ear and human hearing, and to the use of ultrasound in diagnostics.

J. Light and
Modern Physics - Review of atomic structure and electronic configuration. Electromagnetic spectrum and the various forms of energy. Quantum theory. Problems applied to vision, vision correction, color, and optical instruments.

K. Atomic and
Nuclear Radiations - Radioactivity, decay, and half life. Detection of radiation and biological effects. Examples applied to radioisotopes and the detection of x-ray and gamma rays.

L. Laboratory Exercises - To be planned to reinforce the concepts presented in the classroom. Examples are well documented in standard texts and laboratory manuals.

INSTRUCTIONAL OBJECTIVES IN CHEMISTRY

A. Mathematics - Review of fractions, percents, ratios, significant figures, scientific notation, logarithms, algebra, graphing, and conversion of units.

B. Metric System - Review of metric units, measurements, and equivalents in the english system.

C. Basic Concepts of Matter - Atomic structure, electronic configuration, the periodic table, nomenclature, formulas, and the gram mole.

D. States of Matter - Gases, liquids, and solids. Calculations of density, and the gas laws.

E. Chemical Bonding - The nature of chemical bonds, concepts of energy in bonding, formulas, valence, ionic and covalent bonding.

F. Solutions - Preparation, calculation of concentrations, properties, suspensions, colloids and emulsions. Examples applied to fluids in the body.

G. Equations and Stoichiometry - Writing and balancing equations, and stoichiometric calculations.

H. Acids, Bases, and Salts - Ionization, concentration, ph, buffers, and equilibrium calculations. Problems applied to body fluids.

I. Oxidation-Reduction - Balancing equations, and importance of such reactions in the body.

J. Introduction to Organic Chemistry - Survey of organic structures, classification of hydrocarbons and the IUPAC naming system, important reactions, aliphatic aromatic, and heterocyclic compounds.

K. Introduction to Biochemistry - Survey of carbohydrates, fats, and proteins; also, enzymes, body fluids, vitamins, hormones, and metabolism.

L. Laboratory Exercises - To be planned to reinforce experiences and concepts covered in the classroom. Examples are well documented in standard texts and laboratory manuals.

INSTRUCTIONAL OBJECTIVES IN ANATOMY AND PHYSIOLOGY

A. Applications from Chemistry and Physics - Review of the metric system and application of basic chemical and physical concepts to living organisms.

B. Cells and Tissue - Definitions of terms and description of organization, structure, reproduction, and the various tissues.

C. General Anatomy - Definition of terms, body regions, and general anatomical orientation. Description, location and function of organs.

D. Nervous System - Basic elements, building blocks, divisions, and overview of components and functions. Cortical systems and general sensory systems.

E. Sensory Systems - The general, viseral, special sensory, and proprioceptor systems. To include motor systems and evaluations of injury and abnormalities.

F. Skeletal Motor System - Components, structure, function, and development of bone, and disorders, and diseases. Structures, classifications, diseases of joints. Identification and physiology, properties, and responsiveness of muscles.

G. Reproductive System - Male and female systems, and birth control.

H. Circulatory System - Body fluids, anatomy, and functions of the components of this system. Blood and lymph fluids, pressure exchange of nutrients and wastes. Interractions with the respiratory system and diseases and disorders

I. Respriatory System - Components, mechanisms, and functions. Exchange of gasses, capacity, disease and disorders.

J. Nutrition Digestion and Elimination - Components, functions, and chemistry. Absorption of nutrients and elimination of wastes. Principals of metabolism, carbohydrates, proteins, fats, vitamins, minerals, and caloric requirements. Organs and functions of the excretory system.

K. General Endocrinology - General concepts, regulation of hormones, and the glands.

L. Body Defenses - Nonimmunological and immunological processes, drugs and hypersensitivity.

M. Laboratory Exercises - To be planned to reinforce the concepts presented in the classroom. Examples are well documented in standard texts and lab manuals.

INSTRUCTIONAL OBJECTIVES IN PSYCHOLOGY

A. Behavior - Situational, environmental, and organic factors which influence behavior. Situational factors such as location, interractions with people, and activity routines. Environmental factors such as physical and emotional environment and social environment. Organic factors to include general health, heredity, sensitivity, intelligence, interests and motivation. Interactions between person and situation.

B. Behavior Problem Solutions - Correction of situation or environment which creates pressure. Education for modification of attitudes and motivation, and establishment of grievance procedures. Investigation and solution of problems with life style, social and economic pressures, and emotion.

C. Motivation - Physical, social, emotional, and psychological needs as human needs. Priority of needs, and motivational and maintenance needs. Motivational incentives.

D. Frustration - Pressures, failures, interference, and levels. Aggression, regression, resignation, defenses, and mental illness. Solutions such as acceptance, variability, and substitution. Therapy such as catharsis, attitudinal correction, role playing, and counseling.

E. Insights and Communications - Awareness of discontent, and identification of causes. Supportive leadership, higher-needs, motivation, recognition and other rewards, balance of values, and encouragement of creativity. Group decision methods, grievance communications, and job rotations and enrichment.

INSTRUCTIONAL OBJECTIVES IN SOCIOLOGY

A. Social Attitudes - Definitions, terms, evaluation, interpretation, justification, and frames of reference.

B. Factors Influencing Attitudes - Physical condition, emotions, rationalization, experience, personality, group identities, social pressure, education, environment, income, and age.

C. Effects on Attitudes - Influence on behavior creation of prejudices, determination of meaning, and reconciliation of contradictions.

D. Improvement of Attitudes - Development of communication skills, role playing, exposition of problems and feelings, and efforts to correct sources of pressure.

E. Human Relations - History, meaning, and current approaches. Basic concepts of individuality, motivation, ego, dignity, and individual differences. Interactions and relationships between individuals and groups, in familial, social, educational, and professional situations.

INSTRUCTIONAL OBJECTIVES IN ELECTIVE COURSES

There are three intended purposes for requiring the elective courses in the second summer. They are to offer the student the opportunity to:

a. Broaden his education in the humanities, social sciences, or mathematics and science,

b. add depth to his studies in mathematics or science, and

c. make up course work not completed during the first year.

INSTRUCTIONAL OBJECTIVES IN HOSPITAL ORIENTATION

A. Ethics and Professionalism - Definitions, need and value, confidential information, relationships with patients and other hospital personnel, and legal aspects.

B. Hospital Employment - Your position as a technologist and relationships with other personnel in the department. Work duties and deparmental management and procedures. Relationships with business offices, personnel, and other administrative or service departments. Hospital rules and regulations, medical-social-educational benefits, vacation-holiday-sick day benefits, salary and position improvement, and unions and contracts. Job hunting and registration with professional societies. Writing resumes, filling out applications, and appearance and grooming for interviews. Hospital emergency procedures for fires, natural disasters, and mass casualties.

C. Introduction to Nuclear Medical Technology - History of nuclear medicine and description of the field. In-vivo and in-vitro labs, the medical lab, x-ray department, radiopharmac radiotherapy, and other areas utilizing radiation. Radiation safety and the biological effects of radiation exposure. The use of radioactivity for clinical studies, diagnostics, and therapy.

D. Hospital Sepsis and Communicable Diseases - Definitions and identifications. Responsibility for controlling disease and preventive measures. Etiology, manifestations, transmission, preventio barriers, and decontamination for disease.

E. Nursing Procedures - Patient handling while lifting or moving of unencumbered patients and those in casts and traction, and those with I.V., catheter or drainage bag in place. Equipment, techniques, and problems with I.V.'s and vena punctures. Signs and symptoms of emergency complications. Vital signs and CPR.

INSTRUCTIONAL OBJECTIVES IN NUCLEAR MEDICAL TECHNOLOGY 101-102

A. Radiation Physics - Concepts and relationships between mass, energy, and atomic structure are defined as well as the system of units used to describe for electromagnetic forms of radiation as well as particulate forms. Radioactivity is described in terms of nuclear disintegration processes as isomeric and isobaric transition and alpha decay. Calculations for half life, mean life, parent-daughter relationships, and decay curves are performed. Definitions of units of radiation such as the Roentgen, RAD, REM, and RBE are covered. Atomic interactions such as absorption, ionization, photoelectric effect, Comptor scattering, and others are described. The basic factors in radiation dosimetry and the physical characteristics of commonly used radiopharmaceuticals are introduced.

B. Radiation Safety - Calculations for radiation exposure are performed for simple geometries and commonly used units. Definitions for dose equivalent the Curie, specific activity are covered and the relationship between activity and dose rate are explored. Radiation protection guidelines as defined by the National Council on Radiation Protection, the National Regulatory Council (formerly the AEC), and state, local, and hospital guidelines are discussed. Radiation survey methods are covered to include personnel monitoring, area surveys, and acceptable levels. Record keeping and periodic surveying are emphasized. The safe handling of radioactive materials, management of radioactive wastes, and record of radionuclide accountability are discussed. Decontamination techniques and emergency procedures are covered.

C. Radiobiology - The characteristics of the cell and the specialization of tissues in organs are covered. Effects on the cell due to radiation interaction are discussed as well as the factors affecting the differential sensitivity of cells. Interpretation of data and the factors influencing the survival of irradiated cells are presented. The concepts of genetics and the effects of radiation levels required to produce them, and effects which may occur at a later time. Dose rate calculations are expanded to include internal sources, concepts of biological half life, and the factors to be considered for critical organs.

D. Clinical Aspects - In the clinical setting a survey of administrative procedures for the hospital and the department are covered with emphasis on the functional and organizational structure, and relationships between personn and departments. Emphasis is given to ethics, professionalism, and the legal aspec of the profession. Nursing procedures are introduced and observed in regard to patient moving and handling, reviewing charts, techniques used to obtain vital signs, and procedures used in emergency situations. Medical terminology is emphasized to review basics of anatomy and physiology and to introduce common and unusual terms used in nuclear medicine as well as those used specifically for radiopharmaceuticals, instruments, and procedures. The various imaging procedures performed are presented and observed while students are requested to assist in moving patients and delivering paperwork and materials. Students are introduced to photographic techniques, film processing, and dark room procedures, and are requested to assist in dark room production. Radiation protection and the management of radioactive materials are covered and students are expected to observe and to assist in surveying, decontamination, and record keeping procedures.

A. Radiation Detection - Principles of gas filled, and liquid and solid scintillation counters are presented. Area survey and personnel monitoring devices are described, and the principles nuclear medical instrumen and detection system electronic componen are introduced. Counting efficiency to include physical as well as geometrical effects are covered which includes the theory and the application of statistics of counting data.

B. Nuclear Medical Instruments - A survey of the principles of scanners and imaging systems, collimation, photographic and magnetic tape recording, and the use of computer for analysis and display. Static and dynamic imaging systems are included, and the effects of such parameters as resolution, uniformity, linearity, and overall quality control are discussed.

C. Radiopharmaceuticals - The basic concepts of radiochemistry are discussed in regard to radio-chemical separations, generator systems and the production and preparation of radiopharmaceuticals. Tagging compounds, tracer concepts, localizatio of radionuclides, and quality control o materials are presented. Toxicology and the pyrogenicity and sterility testing of commonly used materials are discussed. The in vitro use of radiopharmaceuticals in radio-immunoassay, and the therapeutic use of these materials are introduced.

D. Clinical Aspects - Observation of the calibration and use of area survey and personnel monitoring devic and student assistance in performing periodic surveys, decontaminations, record keeping, and preparation of materials and facilities for hospital and NRC inspections Observation and assistance with record keeping for procedures, radiation safety, radionuclide accountability, instrument performance, and inventory. Observation of and practice with measurements and calculations of counter efficiency, statistics, and dose rates. Use of point and line sources and phantoms are covered. Observation of the use of scanners and imag systems with emphasis on patient position and instrument operation as well as the photographic or magnetic tape recording.

Observation of the use of the computer in data storage and analysis. Observation and assistance with quality control procedures, and the processing of photographic materials in the darkroom. Observation of the storage, preparation, and the administration of radiopharmaceuticals for imaging as well as their use for in-vitro testing and for therapy.

INSTRUCTIONAL OBJECTIVES IN NUCLEAR MEDICAL TECHNOLOGY 105 - 106

A. Clinical Aspects - Students will assist and perform under close supervision the clinical procedures required for a nuclear medical examination. These will include simple therapeutic procedures and in-vitro testing, and as many of the different imaging exams that the department routinely performs, eg; skeletal and soft tissue exams, cardio-vascular, pulmonary, gastrointestinal, neurological, renal, endocrine, and hematological exams. Students will assist and perform under close supervision the preparation and the administration of radiopharmaceuticals, the record keeping required for supplies, accountability, safety, and exposure, the performance of darkroom procedures, radiation safety surve precautions, and record keeping, and the procedures and testing required to assure quality control of instrumentation. Students will perform calculations and experiments designed to determine counter efficiency statistics, effects of collimation, resolution, full width at half maximum, and other procedures deemed important by the department for a particular piece of equipment or examinatic Students will assist and perform under clos supervision the nursing procedures involved with handling, moving, and positioning patients who are unencumbered or attached to oxygen supply, IV's, catheters or drainage bags, preparation and handling of the patient chart, measurements of vital signs, medication orders, and precautions to insure against the spread of disease.

B. Imaging Studies (Didactic) - The in-vivo imaging studies performed statically or dynamically, by scanners or static imaging devices are covered. Althou the material is presented on a general leve attempts to correlate lecture work to specific instruments, hopefully those used in the clinical setting, will be made. Correlation of the didactic and clinical phases are important, and less time is spen in lecture and more time devoted to discuss of procedures and operations of instruments encountered in the clinical setting. Instrument operation and quality control ar stressed in attempts to produce the best images possible. Determination and preparation of doses and radiopharmaceutica are presented.

Anatomy, physiology, and pathology are reviewed for specific clinical studies, eg; those listed above under A, and hopefully, those actually performed in the clinical area.

INSTRUCTIONAL OBJECTIVES IN NUCLEAR MEDICAL TECHNOLOGY 107 - 108

A. Clinical Aspects - The therapeutic use of radiopharmaceuticals and the performance of competitive binding assays are stressed as allowed by the lab facilities in the clinical and didactic areas. Review of anatomy, physiology, and pathology and the use of radiopharmaceutica for thyroid and malignant hematological disorders, and for intracavitary use are presented. Students observe and assist, as allowed by department or hospital policy, in the administration of therapeutic doses, preparation and handling of the materials as well as calculations for dose rates and record keeping.
Review of radiochemistry and radiopharmacy as applied to in-vitro testing with radionuclides. Procedures are presented for as much in-vitro work as occurs in the clinical setting, and hopefully a rotation through the medical lab for several months can be accomplished. Competitive binding assays are covered, eg; thyroxine, T3 and T4, TSH, B12, digoxin and digitoxin, angiotensin I, II, insulin, etc. Students observe and assist, as allowed by department or hospital policy, in the procedures used for testing, radionuclide or kit preparation, measurement and interpretation of data, and operation of equipment.

B. Therapeutic Use and In-Vitro Testing (Didactic) - The theoretical aspects of the use of radionuclide for therapeutic use is covered and includes concepts from radiophysica and radiobiology. Discussion of the effects of radiation on tissue and the success rate previously documented for eliminating disea Anatomy, physiology, and pathology are reviewed. Clinical procedures, safety precautions, and record keeping are discuss in regard to procedures performed in the clinical setting. Correlation of lectures and discussions concerning clinical experiences are important.
The theoretical aspects of the use of radionuclides for in-vitro testing will include basic concepts from radiochemistry and radiopharmacy. Discussion in general terms of all widely performed in-vitro testing being performed by students in the clinical area. Correlation of lectures and discussions concerning clinical experiences are important.

BEHAVIORAL OBJECTIVES IN NUCLEAR MEDICAL TECHNOLOGY 109 - 110

A. Clinical Practicum - Students perform under loose supervision the in-vivo and in-vitro testing, and the therapeutic use of radionuclides that were previously observed and performed under close supervision. Those tests or procedures not previously covered should be done so at this time.

B. Nursing and Administration - All routine nursing and administrative procedures are to be performed independently by students. This includes all phases of patient handling, record keeping and emergency procedures, and all phases of departmental operation including radiation safety, record keeping, and department and hospital procedures.

C. In-Vivo Imaging - All routine imaging procedures including static and dynamic studies performed by scanners and imaging devices. Student checklists are prepared to insure that all students have completed the routine tests. Critiques of student performance will be conducted. If possible, observation and student assistance for more complex, experimental, or research studies will be accomplished. Discussions of latest techniques and equipment will be held. Pathology will be discussed. Emphasis will be based on independent student performance. Group discussions for preparation for the registry exam will be conducted.

D. In-Vitro Testing - All routine competitive binding assays will be performed, and student check lists will be prepared to insure that all students have completed the routine tests. Critique of performance will be held. Pathology and the latest techniques, materials, and instruments will be discussed. If possible, observation and student assistance for more complex, experimental or research studies will be accomplished. Emphasis will be based on independent student performance. Group discussions for preparation for the registry exam will be conducted.

E. Therapeutic Use of Radiopharmaceuticals - All routine procedures for preparing and administering therapeutic doses, as allowed by department or hospital regulations, will be performed by students. Critiques of performance

will be held. Anatomy, physiology, and pathology reviewed. The latest techniques and materials will be discussed, and, if possible, students will observe or assist with experimenta or research work.

F. Radiopharmacy - Students will perform procurement, storage, and the administration of radionuclides. Radiation safety and quality control procedures will be performed and records kept of reports and accountability. Independe student action is expected and performance will be critiqued. Discussions will be held to discuss the newest materials and preparation procedures, and preparation for the registery exam.

G. Photographic Techniques - Students are expected to independently perform the routine procedures, including dark room work, required to produce photographic records. A student's performance is discussed.

RECOMMENDED TEXTS, LABORATORY MANUALS, REFERENCES

English - Writing in college, Kerrigan; Harcourt, Brace and Jovanovich
Writing to the Point, Kerrigan; H.B.J.
Principles of Speech, Monroe; Scott, Foresman
Speech Communication, Ross; Prentice Hall
Handbook of Current English, Perrin et al; Scott, Foresman
Effective English: A Guide for Writing, Canavan; Dickenson Publishing
Report Writing, Graves and Hoffman; Prentice Hall
Techniques of Reading, Jodson et al; H.B.J.
Reference Books: A Brief Guide, Parton and Bell; Enoch, Websters or Heritage Dictionary, Pratt Free Library

Math - Supercalifragilistic, Furgale; Xerox
Elementary Algebra, Stephans; Rienhart
Intermediate Algebra, Leithold: MacMillan
Modern Elementary Statistics, Freund; Prentice Hall
Basic Mathematical Skills, Gossage; McGraw Hill
Essentials of Mathematics, Person; Wiley
Introduction to Technical Mathematics, Washington, Cummings

Chemistry - Basic Chemistry for the Life Sciences, Helmpracht and Friedman; McGraw - Hill
Chemistry, L. Wasserman; Wadsworth
Chemistry Laboratory Manual, Wasserman; Wadsworth
Chemistry for the Health Sciences, Sacheim and Schultz; MacMillan
Chemistry and the Living Organism, Bloomfield; Wiley
Laboratory Experiments for Chemistry and the Living Organism, Bauer and Bloomfield; Wiley
Essentials of General, Organic, and Biochemistry, Routh et al; Saunders
Experiments in General, Organic, and Biochemistry, Routh et al; Wiley

Physics - Physics for the Life Sciences, Crowell; McGraw Hill
Laboratory Manual for Physics for the Life Sciences, Crowell; McGraw Hill
Physics for the Health Sciences, Have and Nave; Saunders
Physics for Biology and Pre-Med Students, Greenberg; Saunders
Laboratory Physics for the Life Sciences, Hayden; Saunders
The Clinical Applications of Physics of Radiation and Nuclear Science, Bogardus; Green, Inc.
Experiments in Nuclear Science, Chase; Burgess.

Anatomy and Physiology - Basic Anatomy and Physiology, McClintic; Wiley
Human Anatomy and Physiology, Hartenstein; Van Nostrand
Anatomy and Physiology, Evans; Prentice Hall
Structure of the Human Body, Gardner and Osbourne; Saunders
Intergrated Science for Health Students, Lankyord; Reston
Anatomy and Physiology, Anthony; Mosby
Lab Manual; Anatomy and Physiology, Anthony; Mosby
Lab Manual of Mammalian Anatomy and Physiology, Grollman, Macmillan
Lab Manual; Introductory Physiology and Anatomy, Haupt et al, Macmillan

Sociology - Social Problems, McKee; Random House
Social Problems, Scarpitti, HRW
Introduction to Sociology, Denisoff; Macmillan
Future Shock, Toffler; Random House
Human Behavior at Work, Davis; McGraw Hill
Human Relations, Ellenson; Prentice Hall

Psychology - Psychology in Action, McKenney; Macmillan
Introduction to Psychology, Hilgard; Harcourt, Brace, and Jovanovich
Readings in Human Development, Roe; Dushkin
Abnormal Behavior, McMahon, Prentice Hall
I'm OK...You're OK., Harris; Harper and Roe
Psychology in Industrial Organizations, Maier; Houghton Mifflin
Motivation and Personality, Maslow; Harper & How

Hospital Orientation - Nuclear Medicine, Wagner; HP Publishing
Learning Medical Terminology, Young and Barger; Mosby
Nuclear Medicine for Technicians, Lange; Year Book Medical
Technology for Patient Care, Bronzino; Mosby
The Dynamics of Health Care, French; McGraw Hill
Nursing of Adults, Smith and Germaine; Lippincott
Taber's Cyclopedic Medical Dictionary, Thomas; Davis
Practical Nurses Medical Dictionary, Schmidt; Thomas
Your Body and Radiation, USAEC
Radiological Health Handbook, USEPA

Nuclear Medical
Technology Courses - Nuclear Medicine for Technicians, Lange; Year Book Medical Publishers
Nuclear Medicine Technology, Early et al; Mosby
Basic Science Principles of Nuclear Medicine, Boyd and Dalrymple; Mosby
Principles of Radioisotope Methodology, Chase and Rabinowitz; Burgess
Radioactive Nuclides in Medicine and Biology, Quimby et al; Lea and Febiger
Clinical Nuclear Medicine, Maynard; Lea & Febiger
Radiopharmacy, Tubis and Wolf; Wiley
Radiopharmaceuticals, Subramanian et al; SNM
Fundamentals of Radiobiology, Bacq and Alexander; Pergamon
Medical Radiation Biology, Dalrymple et al; Saunders
Introduction to Health Physics, Cember; Pergamon
Radiological Health Handbook; Bureau of Radiological Health
Radiation Biophysics, Andrews; Prentice Hall

MEDICAL IMAGING AND RADIATION TECHNOLOGY CORE PROGRAM
GENERAL DESCRIPTION

A two year associate in science degree program was designed to satisfy the needs for training for radiologic, nuclear medical, ultrasound, radiotherapy, and biomedical technologists. A survey of existing literature (References 1,7, 8, 9) indicated that enough similarity existed between all of the diagnostic and the therapeutic specialties to allow for a common core of basic courses which could satisfy the preparatory academic requirements of each specialty. While this report presents the two year curriculum for a nuclear medical technology option only, it was the intent of the study to have the course selections for the first year specified for the NMT option satisfy the requirements for the specialties listed above. Other specialties such as thermography, mammography, xeroradiography, electron radiography, special procedures, and floroscopy which are currently being handled by radiologic technology should, at this time, remain there, as did nuclear medicine and ultrasound, until they too have grown in the numbers and types of procedures and services offered to warrant special attention and specialized educational programs. Perhaps that time is not too far off as in the case of dosimetry and radiation therapy. However, if and when a separation does occur it is believed that these specialties too can enter the family of programs offered to imaging and therapy technologists and share in the offerings of a core program.

A core of related programs has so much to offer students, professionals, organizations, and the profession. With a core program that has several specialized options, there exists the flexibility to change the number of entering students in any one specialty so as to adjust to local or regional changes in the job market and the technology. This flexibility offers the student the opportunity to change his specialization prior to his second year based on his increased awareness of the field gained during his first year; to the college the ability to adjust numbers of students in individual options while maintaining a significant number of total students in the entire program to warrant the offering of specialized courses and services that these students will need; to hospitals the opportunity to more easily change the number of students presently in an option based on near future projections of the need for technologists, and the opportunity to fill more easily vacancies in other departments fro the larger number of students present in the total program; and to the profession increased communication and cooperation between departments and hospitals who are really trying to do their best by offering the best medical services possible. Perhaps a new community spirit will grow amongst the members of diagnostic and therapeutic professions.

Students in each option will take all of the courses in their first year, and then go off in groups ranging from four to eight students to different hospitals or to different departments in one hospital to continue with their studies in the clinical and didactic phases of their training.

Not all options need to be twentyseven months long as is the NMT option, but for students who are recent high school graduates or who have no previous medical experience at least twentyfour months is required.

For professionals who have previously worked in the field, and who have accredited and certified medical training, a minimum of twelve months clinical training would be required to satisfy AMA requriements, and perhaps an additional course or two as a refresher.

COOPERATIVE RELATIONSHIPS

The core program was designed as a cooperative relationship between a community college and several hospitals. The intent was to give the college the responsibility for administering the program and the granting of the degree of Associate in Science. There are about twelve programs of this nature (Reference 3) in the country, most of which consist of such an affiliation, but for usually only one program or perhaps two. Several programs have multiple specialties, and references 3 and 4 describe those programs at Denver Community College and at the British Columbia Institute of Technology.

Affiliation agreements and contracts between colleges and hospitals have been documented in the literature, eg; Reference 11 contains the contract between Springfield Technical Community College and Wesson Memorial Hospital. Such contracts which do not have exclusivity clauses can be signed between a college and several hospitals, and will add to the relationships through increased communications and sharing of resources and facilities.

Much can be gained from such relationships if a spirit of cooperation and friendly competition is maintained. Students in various programs will have the advantage of rotations to different hospitals, be they public or private institutions serving small or large communities or perhaps even institutions involved in research and higher education. Exposure of the student to such diverse hospital environments will offer a wide breadth of experiences which can only increase his cosmopolitan and communal senses. Professional and social acquaintences or relationships will add to the profession more friendly, cordial and respectful attitudes. Job hunting will be much simpler, as will the selection of new employees as the word circulates as to which organization does what better and which prospect would be best for a particular organization. In addition, from the technical point of view there will be more sharing of information, procedures, and, perhaps, services and personnel. Rotation of clinical instructors, as an example or perhaps computer analysts, may be possible so as to reduce unnecessary duplication of efforts for educational programs which usually have small enrollments. As the restrictions on hospital costs increase, and the ability of hospitals to purchase expensive equipment decreases, the rotation method may be the only way in which students can be exposed to expensive machinery such as computers, CAT scanners, whole body scanners, linear accelerators, etc.

The disadvantages of such a program for students centers around their need to travel to different institutions and the familiarization with the facility, the staff, and the procedures for each. Of course, they will be evaluated by many more people, which may or may not be a disadvantage, and they will certainly be held responsible for much more knowledge of a technical and procedural nature.

For hospitals the disadvantages will deal mostly with familiarization of new groups of students several times a year. However, since the groups may be as small as two or four at a time, individual departmental staff members should be able to facilitate the handling and the familiarization of the new student without disruptions in the daily work schedule of the department.

For the college the core program will need more personnel, staff, and support when compared to programs in non-clinical areas which service about the same number of students. Separate applications, procedures, arrangements, and accreditations may be necessary for each hospital. However, there is really no alternative if colleges wish to service the needs of and cooperate with the medical community. Clinical programs such as these usually demand small numbers of students, and when this core program is compared to the operation of separate programs in each area the cost factors favor the core. If colleges attempt to cut their costs and increase their efficiency by increasing the number of students, cooperation from the hospitals will cease and perhaps the entire program. Hospitals cannot tolerate large numbers of students in their working areas, nor will they be able to employ upon completion of the program the larger numbers forced by the college. Therefore, the clustering of several small programs around a core appears to be overall less costly, more efficient, and broader educationally than the operation of several separate programs.

CONCLUSIONS AND RECOMMENDATIONS

The cooperation for educational programs between colleges and hospitals has been growing in recent years in the general field of the radiologic sciences, and the associations have been cordial, efficient and beneficial to all concerned (References 4, 5)

While there has been a relatively large growth (compared to employment opportunities) in the field of radiologic technology there has been a low growth rate for programs in nuclear medical technology (again compared to employment opportunities). Employment opportunities documented in references 2 and 6 indicate that employment and career opportunities for NMT's have been growing at a very great rate in recent years; a rate which has out paced the establishment of career programs and the delivery of trained technologists.

The growth rate in NMT offers to trained radiologic technologists an expansion into a related area that they could easily enter and become certified. It was the intention of this study to allow registered technologists the opportunity to enter the program in the second year.

A review of Connecticut Community College catalogs such as reference 10 and proposed curricula (references 5, 11) indicates that most colleges offer all of the basic academic courses required as prerequisites to the various specialties in the radiologic sciences, and that core programs make sense from an academic or technical point of view, but pose problems in liaison and coordination.

The core program presented can serve as a model for other clinical or specialized programs which deal with more than one institution in several areas where enrollments for any one area might, of necessity, be small. However, startup of these programs are difficult, for each option in such a cluster requires the same amount of research, production, coordination, liaison, approval, and administration of procedures as a full time program.Studies such as this presented for the NMT option wil be repeated for ultrasound, radiotherapy, and biomedical technology.

It became clear during the course of this work that the overall recommendation was to encourage continued cooperation between colleges and outside institutions in the development of career training programs for students. This cooperation is essential if educational organizations are to be able to present viable training programs which are of use to industry and employer

The cluster concept for educational programs needs support for the startup and the coordination and the liaison necessary for such programs. Without such support there may be little contact, lack of communication, and often bad feelings generated between institutions. The continued involvement of staff members in the operations of other organizations is essential to the success of such a program.

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2. Studies of Educational Programs and Employment Opportunities in Health, Connecticut Institute for Health Manpower Resources, Commission for Higher Education.
3. Allied Medical Education Directory, AMA;Development of Career Opportunities for BMET's, TERC.
4. A Case Study of the History and Development of an NMT Educational Program, Technical Education Research Centers.
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7. Essentials of an Accredited Educational Program for the Radiation Therapy Technologist, Revised Dec. 1976, AMA.
8. Essentials of an Accredited Educational Program for Radiologic Technologists, Revised Dec. 1969, AMA.
9. Curriculum Guide for Programs in Radiologic Technology, Sept 1976, American Society of Radiologic Technologists.
10. Middlesex Community College Catalog, 1976.
11. A Suggested Post Secondary Curriculum in Nuclear Medical Technology, TERC.

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13. Fundamentals of Radiobiology, Bacq and Alexander; Pergamon
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17. Intro to Physics for Radiologic Technologists, Graham and Thomas; Saunders
18. The Physics of Radiography, Ridgeway and Thumm; Addison Wesley
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20. Ultrasonic Biophysics, Dunn and O'Brien; Halstead
21. National Nuclear Medicine Seminar, Squibb Co.
22. Nuclear Medicine Technology, Technical Education Research Center
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24. Career Ladder Concept in Nuclear Medical Technology, TERC
25. Workshop Manual for Quality Control of Scintillation Cameras in Nuclear Medicine, Bureau of Radiological Health
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27. Technology for Patient Care, Bronzino; Mosby
28. Biomedical Equipment Technology, Technical Education Research Centers
29. Basic Electronics for Scientists, Brophy; McGraw Hill
30. Medical Instrumentation for Health Care, Cromwell et al; Prentice Hall
31. Biomedical Instrumentation and Measurements, Cromwell et al; Prentice Hall
32. An Introduction to Biomedical Instrumentation, Dewhurst; Pergamon
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35. Scintillation Camera with 11 inch Crystal, Hal Anger, USAEC Report.
36. Proceedings of 6th Symposium, Society of Nuclear Medicine
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38. Tomographic Imaging in Nuclear Medicine, SNM
39. Computer Processing of Dynamic Images, SNM
40. Radiopharmaceuticals, SNM

APPENDIX A
ABSTRACT

Title of Project: Curriculum Development For Nuclear Medicine Technology

Project Director: Albert Buatti, Associate Professor In Science

Applicant Organization: Middlesex Community College, Middletown, Connecticut

Total Project Funds: $6672 (State/Federal: $3340 Local: $3332 In-kind)

Beginning Date: January 14, 1977 Ending Date: June 30, 1977

Objectives: To develop the curriculum and the procedures for the clinical phase of training for Nuclear Medicine Technologists.

To develop a procedure for the operation of a Medical Radiation Technology core program which will encompass a cluster of five related diagnostic and therapeutic technologies:

1. Radiologic Technology,
2. Nuclear Medicine Technology,
3. Ultrasound Technology,
4. Radiotherapy Technology,
5. Biomedical Technology.

Procedures: The project director will spend one day per week for six months working at Hartford Hospital for the purpose of producing curriculum materials for the Nuclear Medicine Technology program.

Also, he will consult with the staff at the University of Connecticut Health Center and at Yale-New Haven Hospital to observe the latest clinical techniques and to develop the procedures for the coordination of several programs at these hospitals.

Contribution to Education:

Nuclear Medicine Technology is a new and emerging career for which educational materials must be developed.

The development of a core program that can service as many as five career programs will help to relieve the problem that occurs in health programs due to the conflicting needs of the cooperating institutions; Colleges need many students in a program - Hospitals can handle only a few.

The Curriculum materials developed may be used in similar programs at other colleges and hospitals.

The core program in Medical Radiation Technology can serve as a model for future core programs.

Essentials of an Accredited Educational Program for the Nuclear Medicine Technologist

(Revised June, 1976)
Established by
AMERICAN MEDICAL ASSOCIATION
COUNCIL ON MEDICAL EDUCATION
in collaboration with
AMERICAN COLLEGE OF RADIOLOGY
AMERICAN SOCIETY FOR MEDICAL TECHNOLOGY
AMERICAN SOCIETY OF CLINICAL PATHOLOGISTS
AMERICAN SOCIETY OF RADIOLOGIC TECHNOLOGISTS
SOCIETY OF NUCLEAR MEDICINE

The organizations indicated above have obvious interest and concern in the development of educational programs designed to prepare the nuclear medicine technologist. To organize their concerns and provide an orderly mechanism for both program evaluation and preparation of recommendations on accreditation status, these organizations have established a Joint Review Committee on Educational Programs in Nuclear Medicine Technology. As the agent of the five sponsoring organizations and of the Council on Medical Education in matters relating to educational programs in nuclear medicine technology, the Joint Review Committee is dedicated to the maintenance of high standards of education. Its membership is comprised of representatives from each of the sponsoring organizations.

The education and health professions cooperate in establishing and maintaining standards of appropriate quality for educational programs in nuclear medicine technology and in providing recognition for educational programs that meet or exceed the minimum standards outlined in these *Essentials*. These standards are to be used as a guide by the Joint Review Committee and program directors.

DESCRIPTION OF THE OCCUPATION

The practice of nuclear medicine includes the utilization of radioactive materials for therapeutic and diagnostic, "in vivo" and "in vitro" procedures and any combination thereof. The skills of the nuclear medicine technologist shall complement those of the nuclear medicine physician and other professionals in the field.

The *nuclear medicine technologist* must be able to perform effectively in three major areas of responsibility:

A. **Patient Care**
   1. Must understand and relate to the patients' concerns and fears about their illnesses and pending diagnostic procedures or therapy.
   2. Must recognize emergency patient conditions and initiate life-saving first aid prior to the arrival of a physician.

B. **Technical Skills**
   1. Prepares and manages quality control of radiopharmaceuticals to patients by intravenous, intramuscular, subcutaneous, and oral methods.
   2. Understands and utilizes radiation detection devices and other laboratory equipment that measure the quantity and distribution of radionuclides deposited in the patient or a patient specimen.
   3. Performs "in vivo" and "in vitro" procedures, understanding these tasks sufficiently well to supplement selected examinations and procedures for the benefit of the patient and to improve the diagnostic quality of the data produced.
   4. Utilizes his knowledge of radiation physics and safety regulations to practice radiation safety, thereby limiting the exposure to the patient, the public, and fellow radiation workers to acceptable, minimal levels of radiation.
   5. Is aware of quality control techniques and applies them appropriately to all procedures and products in the laboratory.
   6. Participates in research activities that demand a thorough knowledge of the many facets of nuclear medicine.

C. **Administrative Functions**
   1. May supervise other nuclear medicine technologists, laboratory assistants, and other personnel.
   2. Participates in the procurement of supplies and instrumentation required to operate the facility.
   3. Records all operations of the laboratory including the receipt and disposition of radioactive materials, instrument and procedural quality control data, patient procedures, and medical records.

REQUIREMENTS FOR ACCREDITATION

I. INSTITUTIONS THAT MAY ESTABLISH PROGRAMS

A. Junior and Senior Colleges, Universities, and Technical Vocational Institutes
B. Hospitals and Clinics
C. Medical Schools

The institution must be accredited or otherwise acceptable to the Council on Medical Education of the American Medical Association. Colleges, universities, and technical vocational institutes without clinical facilities must have appropriate clinical affiliations.

II. INSTRUCTIONAL FACILITIES

A. **General** - Adequate classrooms, laboratories, and clinical facilities must be provided.
B. **Laboratory** - Appropriate modern equipment and supplies for directed experience must be available in sufficient quantities for full participation by the individual student.
C. **Library** - A library must be readily accessible and contain an adequate supply of current reference volumes, periodicals, and other material related to the curriculum.

III. CLINICAL FACILITIES

A. The clinical phase of the educational program must be conducted in a broad clinical setting under competent medical direction.
B. In the clinical teaching environment, an effective ratio of students to clinical instructors must be maintained.
C. The type and quantity of nuclear medicine procedures must be adequate for the clinical training of the student.
D. The clinical facility must have adequate quantity and varieties of nuclear medicine instrumentation to allow for student instruction.
E. Where classroom and clinical instruction are not provided in the same institution, accreditation will be granted to the sponsoring institution, as identified by established AMA criteria. *However, responsibility for quality of the total teaching program must be shared by both institutions involved (i.e., college and hospital).*

IV. FINANCES

A. Financial resources for continued operation of the educational program must be assured through regular budgets.

B. The institution shall not charge excessive student fees.

C. The sponsoring institution or its clinical affiliates must not substitute students for paid personnel to conduct the work of the clinical faculty.

V. ADMINISTRATORS AND FACULTY

A. **Educational Directors**

The educational direction shall be assumed by a physician, nuclear medicine technologist, or other allied health personnel (i.e., physicist, professional educator).

Every program must have a qualified medical director and nuclear medicine technologist director responsible for the clinical training, program coordination and for the organization, administration, periodic review, continued development, and general effectiveness of the program.

B. **Medical Director**

The medical director must be a physician qualified in the use of radionuclides and a diplomate of the American Board of Nuclear Medicine, Nuclear Radiology, a subspecialty of the American Board of Radiology, or Radioisotopic Pathology, a subspecialty of the American Board of Pathology, or have qualifications acceptable to the Council on Medical Education.

The medical director of the program shall provide competent direction for the clinical instruction and for clinical relationships with other health and medical educational programs and should develop the understanding and support of practicing physicians.

C. **Technologist Director**

The technologist director shall devote full time to the laboratory where the educational program is conducted. The technologist must be certified in nuclear medicine technology by the American Society of Clinical Pathologists Board of Registry or the American Registry of Radiologic Technologists. This technologist must have at least three years of experience at a combination of staff and senior nuclear medicine technologist levels and shall have education and experience embracing methods of instruction, educational psychology, and human relations.

D. **Faculty Appointments**

If the clinical facility is not an integral part of the institution initiating the program (i.e., university, technical vocational institution), the physician, technologist director, and instructors shall be members of the faculty or staff of the sponsoring institution.

E. **Change of Director**

If any of the directors of the educational program are newly appointed, immediate notification must be sent to the AMA Department of Allied Health Evaluation. The curriculum vitae of the new directors, which should include details of training, education, and experience in the field, must be submitted. If the new director's credentials are satisfactory, accreditation of the program will be continued.

F. **Teaching Staff**

The instructional staff must be qualified through academic preparation and experience to teach the subjects assigned. Faculty shall have adequate and appropriate training in the areas of curriculum design and teaching techniques. The staff shall include at least one instructor who is certified in nuclear medicine technology and actively engaged in the clinical practice of nuclear medicine technology. A planned program for the continued education for the faculty shall be provided.

G. **Advisory Committee**

For programs involving more than a single institution, an advisory committee must be appointed to assist the directors in continuous program development and evaluation, in faculty coordination, and in ensuring effective clinical relationships. Programs having minimal or no extra-institutional activities shall provide for periodic review and updating of program standards and curriculum content by the director and institutional staff.

VI. STUDENTS

A. **Selection** - In colleges, universities, and technical vocational institutes, selection of students shall be made in accordance with the generally accepted practice of the institution. Directors of the clinical aspects of the program shall be involved in the selection. In hospital-sponsored programs, selection of students must be made by an admissions committee of individuals responsible for the program. Admissions data shall be on file at all times in colleges, universities, or hospitals sponsoring the program.

B. **Admission Requirements** - Persons admitted into nuclear medicine technology programs shall have completed high school or its equivalent and have completed post-secondary courses in the following areas:

1. Anatomy and Physiology
2. Basic Physics
3. Basic Mathematics
4. Medical Terminology
5. Oral & Written Communications
6. General Chemistry
7. Psychology and Sociology
8. Medical Ethics and Jurisprudence

Under unusual circumstances some of the prerequisites may be completed during the year of nuclear medicine training.

Qualified medical technologists, M.T. (ASCP) or eligible, radiologic technologists, R.T. (ARRT) or eligible, and registered nurses, R.N. are presumed to have the necessary credentials to meet the entrance requirements.

Educational institutions such as junior colleges, universities, and technical vocational institutes may provide these prerequisite courses as part of an integrated program in nuclear medicine technology (i.e., 2 to 4 years). In these programs, educational institutions are encouraged to provide such basic elements of a general education as are necessary to qualify the students for an associate or bachelors degree.

C. **Health** - Applicants shall be required to submit evidence of good health. Student health service shall be available for evaluation and maintenance of the student's health. When students are learning in a clinical setting or a hospital, the hospital or clinic shall provide students with the protection of the same physical examinations and immunizations as are provided to hospital employees working in the same institution.

VII. STUDENT RECORDS

Satisfactory records of student performance in the educational program shall be maintained. Monthly and annual reports of the department must be prepared and available for review. Records shall include the following:

A. Transcripts of high school and college credits and other pre-admission credentials.

B. Certification by a physician as to the candidate's good health upon admission.

C. Record of class and laboratory participation and accomplishment of each student in accordance with requirements of the institution.

D. Attendance and grades.

E. Record of clinical performance under supervision.

VIII. PROFESSIONAL CURRICULUM

A. **Length**

1. **General** - The structure of the curriculum shall be based on not less than one calendar year of full-time study. This is to provide didactic content of appropriate scope and depth as well as clinical experience of sufficient variety to develop needed knowledge and skills.
2. **Innovative Programs** - Performance objectives for all phases of curriculum and for graduation shall be clearly defined in terms of measurable behavior. Therefore, the curriculum may also be structured to allow students to progress at an individual pace. This will provide an opportunity for students to meet performance standards specified for graduation in less than normal curriculum length as well as provide an opportunity for students who require more time to extend the length of their instructional program. *Students completing the program in less than one year must be advised of current requirements of national certifying bodies.*

B. **Structure** - Instruction should follow a planned outline which includes:

1. Assignment of appropriate instructional material.
2. Classroom presentations, discussions, and demonstrations.
3. Supervised clinical experience.
4. Examinations, oral and written, for didactic and clinical aspects of the program.

C. **Content**

a. Patient Care
b. Nuclear Physics
c. Instrumentation and Statistics
d. Health Physics
e. Biochemistry
f. Immunology
g. Radionuclide Chemistry
h. Radiopharmacy
i. Administration
j. Radiation Biology
k. Clinical Nuclear Medicine - "in vivo" and "in vitro" studies
l. Radionuclide Therapy
m. Introduction to Computer Application/operation or data manipulation

D. **Records** - Complete curriculum shall be kept on file including rotation of assignments, lists of instructional aids used to augment the learning experience of the student, copies of the course outlines, and class schedules. Directed experience and teaching plans shall be kept on file and available for review. Copies of the practical and written examinations should be maintained and continually re-evaluated.

IX. EDUCATIONAL OBJECTIVES

After participation in the program, each student must be expected to have attained a certain level of knowledge and understanding that is consistent with specific performance objectives. Following is a minimal list of objectives.

A. Physical Science. The technologist must demonstrate a fundamental knowledge and understanding of the following:

1. elementary aspects of the structure of matter with special emphasis on the composition, stability, and energy levels of atomic nuclei.
2. modes of radioactive decay with special emphasis on beta decay, electron capture, metastable states, and internal conversion.
3. particle and photon radiation accompanying radioactive decay with special emphasis on photon radiation.
4. interactions of radiation with matter, with special emphasis on photoelectric and Compton interactions.
5. radiation detectors with special emphasis on scintillation and semi-conductor detectors for photons.
6. collimated radiation detectors with special emphasis on the characteristics of flat-field, focused, parallel-hole diverging, and pin-hole collimators in response to point, line, and plane sources.
7. electronic instruments such as amplifiers, pulse-height analyzers, scalers, count-rate meters, and computers.
8. statistics of counting random events.
9. mathematical operations including logarithms and exponential functions.

B. Radiation biology and protection. The technologist must demonstrate a fundamental knowledge and understanding of:

1. the biologic effects of radiation exposure.
2. administrative and technical means of reducing unnecessary radiation exposure to patients, personnel, and environment.
3. techniques of measuring levels of radioactive contamination and techniques of decontamination.
4. government regulations regarding exposure and material handling.

C. Radiopharmaceuticals. The nuclear medicine technologist must be able to demonstrate knowledge and understanding of radiopharmaceuticals in the following specific areas:

1. production of radionuclides by reactors and particles accelerators, the use of radionuclide generators, the concept of specific activity and the special chemical characteristics of the carrier-free state.
2. formulation of radiopharmaceuticals including general techniques of preparing agents used in the nuclear medicine laboratory, quality control procedures including tests for radiochemical purity, quantitative assay, sterility and pyrogens.
3. operation of electronic equipment appropriate for radioassay and quality control.
4. understanding of biochemical and physiological properties or radiopharmaceuticals including the mechanism of localization.

D. "In vivo" procedures (imaging and "in vivo" laboratory work). The technologist must demonstrate knowledge and understanding of:

1. stationary and moving radionuclide imaging devices.
2. stationary imaging include: imaging of brain, cerebral spinal fluid spaces, thyroid, lung, heart, liver, spleen, kidney, bones, and other organ systems.
3. the use of single and multiple detectors for time-dependent studies such as cerebral bood flow, thyroid uptake, cardiac output, differential renal function.
4. body composition tests such as blood volume, red blood cell volume.
5. erythrokinetic studies including red cell production and destruction and quantification of blood loss.
6. gastrointestinal absorption studies of substances such as iron, vitamin B12.
7. gastrointestinal loss studies such as proteins, blood.

E. "In vitro" procedures. The technologist must demonstrate knowledge and understanding of:

1. the hazards of working with toxic chemicals, infectious biologic materials, and radionuclides, and be especially aware of the proper handling and disposal of such materials.
2. common laboratory instruments and equipment including pipets, centrifuges, pH meters, analytical balances, calculators, and scintillation counters.
3. the principles of saturation analysis and competitive protein binding assays in order to follow a protocol,

with an appreciation of the indications for and limitations of the technique including procedures such as principles of physiology and biochemistry pertaining to specimen collection and analyses.

4. good laboratory quality assurance program, how to set up such a program, and an appreciation of the necessity of maintaining adequate laboratory records.

F. Therapeutic uses of radionuclides including knowledge and understanding of:

1. the more common therapeutic applications of radionuclides, dose ranges for each indication, and proper techniques for calculating quantities of administered radiopharmaceuticals.
2. special problems of patient care, radiation safety, and follow-up.
3. special problems of handling excreta from such patients.

X. ADMINISTRATION

A. **Catalog** - An official publication including a description of the curriculum shall be issued at least biennially. It shall include information regarding the organization of the program, a brief description of required courses, names and academic rank of faculty, entrance requirements, tuition and fees, and information concerning hospitals and facilities used for directed experience. The catalog must also include information about the current accreditation status of the program.

B. **Accreditation** - Evaluation, including survey team visits, of a program of study can only be initiated by the express invitation of the chief administrator of the sponsoring institution or his officially designated representative.

C. **Withdrawal** - The institution may withdraw its request for initial accreditation at any time (even after evaluation) prior to final action. The AMA Council on Medical Education and collaborating organizations may withdraw accreditation whenever the educational program is not maintained in accordance with the standards outlined above, or when there are no students in the program for two consecutive years. Accreditation may be revoked only after notice in time to review and respond has been given to the chief administrative officer of the sponsoring institution and program director indicating that such action is contemplated and providing reasons therefor.

D. **Re-evaluation and Review** - The program director and chief administrative officer are given the opportunity to become acquainted with the factual part of the report prepared by the visiting team and to comment on its accuracy before final action is taken. At the request of the institution, a resurvey may be made. Accreditation decisions may be appealed by letter to the Council on Medical Education of the American Medical Association.

E. **Reports** - An annual report must be made to the AMA Council on Medical Education and collaborating organizations through the Joint Review Committee on Educational Programs in Nuclear Medicine Technology. A report form is provided and should be completed, signed by the director of the educational program, and returned promptly.

F. **Resurvey** - The AMA and collaborating organizations will periodically resurvey educational programs for consultation and evaluation.

APPLICATIONS AND INQUIRIES

A. **Accreditation**

Application for accreditation of a program shall be made to:

DEPARTMENT OF ALLIED HEALTH EVALUATION
Division of Medical Education
American Medical Association
535 N. Dearborn Street
Chicago, Illinois 60612

B. **Careers**

Inquiries regarding career information should be addressed to:

AMERICAN COLLEGE OF RADIOLOGY
20 North Wacker Drive
Chicago, Illinois 60610

AMERICAN SOCIETY FOR MEDICAL TECHNOLOGY
5555 West Loop South, Suite 200
Bellaire, Texas 77401

AMERICAN SOCIETY OF CLINICAL PATHOLOGISTS
2100 West Harrison Street
Chicago, Illinois 60612

AMERICAN SOCIETY OF RADIOLOGIC TECHNOLOGISTS
500 North Michigan Avenue, Suite 836
Chicago, Illinois 60610

SOCIETY OF NUCLEAR MEDICINE
475 Park Avenue South
New York, New York 10017

C. **Registration — Certification**

Inquiries regarding registration or certification of qualified graduates of the accredited program shall be addressed to:

AMERICAN REGISTRY OF RADIOLOGIC TECHNOLOGISTS
2600 Wayzata Boulevard
Minneapolis, Minnesota 55405

BOARD OF REGISTRY
American Society of Clinical Pathologists
2100 West Harrison Street
Chicago, Illinois 60612

APPENDIX C

Society of Nuclear Medicine Technologist Section

VOICE GENERAL INFORMATION

What is VOICE? VOICE (Verification of Involvement in Continuing Education) is a continuing education accounting program developed and offered by the Technologist Section of the Society of Nuclear Medicine. This program offers a permanent, official computerized record of continuing education activities related to nuclear medicine tecnnology. VOICE awards points for participation in a variety of activities. Persons who accumulate a total of 150 points in a 2 year period are awarded a Cerficate of Continuing Education.

Why did the Technologist Section develop the VOICE program? The rapid change in nuclear medicine equipment and clinical procedures, and the concern of the public for quality health care and radiation safety, require that today's nuclear medicine technologists continue their educational involvement beyond basic training. Continuing education is also being considered as a popular alternative to certification by examination. VOICE offers the technologist a method of maintaining a comprehensive, permanent record of all educational experiences. The VOICE program has been in existance since June, 1976.

What kind of credits are earned?

CEU - Continuing Education Units

The CEU is the nationally accepted measure of continuing education in a formal setting. The CEU is defined by the National Task force on Continuing Education as follows: "One CEU is 10 contact hours of participation in an organized continuing education experience under responsible sponsorship, capable direction, and qualified instruction. The CEU has educational value, is recognized nationally, and promotes high quality educational programs which may lead to an increased professional development of individuals".

CEU courses sponsored by the Technologist Section must be at least 5 hours in length and may be offered within a single session or over a longer period of time. CEU credit is only awarded to attendees who successfully complete an evaluation examination or project at the end of an accredited course.

(100 points are awarded for 1.0 CEU. At least 1.0 CEU is required for the Certificate)

VUE - Verified Unit of Education

VUE credit is awarded to persons having successfully completed the evaluation examination or program of a CEU course, so accredited by an organization other than the Technologist Section.

(100 points are awarded for 1.0 VUE. However, only 50 points can be used towards the Certificate)

PAR - Professional Activities Recognition
This category recognizes educational experiences, which although relevant and of equivalent quality content, do not meet the criteria for CEU or VUE credits: attendance at professionally related lectures, symposia, and workshops (2 points per hour), publication of articles, books, etc., (10 points per publication), presentation of scientific papers, exhibits, and lectures (10 points per presentation), and service in professional organizations as an officer or committee member (5 points per year of service). (A maximum of 20 points can be used towards the Certificate)

Who can join VOICE? Membership in the VOICE program is open to all persons interested in maintaining a record of continuing education activities. Members of the Technologist Section of the Society of Nuclear Medicine are offered VOICE membership at a lower cost than non-members.

VOICE membership details: The VOICE program membership year is June 1 to the following June 1. Applications are accepted at any time during the year, but it is recommended that technologists apply early on to take full advantage of the program. The membership fee remains consistant throughout the year: members of the SNM Technologist Section pay $7.00, non-members of the SNM Technologist Section pay $15.00, and persons applying simultaneously to the Technologist Section and VOICE pay $7.00 (this $7.00 does not included the SNM or Section application fee).

Receipt of VOICE dues initiates computer documentation of continuing education activities.

Credit is not retroactive.

There is no billing for VOICE dues. Eventually billing will be computerized. Until that time, a check or money order made payable to the Society of Nuclear Medicine must accompany the membership application.

A VOICE card will be sent within three weeks of receipt of the membership application, indicating the member's full name, VOICE identification number, and card expiration date.

VOICE membership is renewed annually, preferably in April or May.

APPENDIX D

NAVAL TRAINING PROGRAMS

NV-0705-0004

NUCLEAR MEDICINE TECHNICIAN
(Nuclear Medicine Technic)
Course Number: B-322-0010
Location: Submarine Medical Center, Groton, CT.
Length: 12 weeks (355-398 hours).
Dates: 1/63 - Present.
Objectives: To train enlisted personnel in radiation monitoring and surveys.
Instruction: Lectures and practical exercises in radiation monitoring and surveys, including radiological administration, mathematics, physics, reactor plant technology, radiobiology, and dosimetry.
Credit Recommendation: In the vocational certificate category, 6 semester hours in algebra, 6 in physics, and credit in nuclear medical technology, radiology or occupational safety and health on the basis of institutional examination (7/74); in the upper-division bacalaureate category, 6 semester hours in algebra, 6 in physics, and credit in nuclear medical tecnnology, radiology, occupational safety and health on the basis of institutional examination (7/74).

NV-0705-0003

X-RAY TECHNIQUE
(X-Ray Technician, Class C)
(X-Ray Technic)
Course Number: B-313-26; B-313-27; B-313-28; B-313-29; B-313-30; B-313-31; B-313-32; B-313-33; B-313-34
Location: Naval Hospital, Bethesda, MD; Naval Hospital, Portsmouth, VA; Naval Hospital, San Diego, CA; Naval Hospital, St. Albans, NY; Naval Hospital, Cp. Pendleton, CA; Naval Hospital, Chelsea, MA; Naval Hospital, Great Lakes, IL; Naval Hospital, Oakland, CA; Naval Hospital, Philadelphia, PA.
Length: 52 weeks (2080-2087 hours).
Dates: 1/54 - Present.
Objectives: To train technicians to operate medical x-ray equipment, to produce and process diagnostic radiographs, to assist in the application of radiation therapy, and to assist in fluoroscopic examinations.
Instruction: Lectures on mathematics and electricity; clinical application of radiologic and fluoroscopic techniques; photodosimetry and radiation safety; film, screen, and darkroom procedures; and radiation therapy.
Credit Recommendation: In the vocational certificate category, 12 semester hours in radiologic technology, 2 in radiation therapy, 3 in physical science and mathematics, and additional credit in radiologic technology on the basis of

institutional examination (2/74); in the lower-division baccalaureate/associate degree category, 12 semester hours in radiologic technology, 2 in radiation therapy, 3 in physical science and mathematics, and additional credit in radiologic technology on the basis of institutional examination (2/74); in the upper-division baccalaureate category, 12 semester hours in radiologic technology, 2 in radiation therapy, 3 in physical science and mathematics, and additional credit in radiologic technology on the basis of institutional examination (2/74).

NV-0705-0002

1. CLINICAL NUCLEAR MEDICINE TECHNICIAN
   (Clinical Nuclear Medicine Technique)
2. RADIOACTIVE ISOTOPE TECHNICIAN, CLASS C
   (Radioactive Isotope Technic)

Course Number: All versions: B-311-16. Version 2: B-311-17

Location: All versions: National Naval Medical Center, Bethesda, MD. Version 2: Naval Hospital, San Diego, CA.

Dates: Version 1: 3/72 - Present. Version 2: 1/58 - 2/72.

Objectives: To train personnel to operate and maintain radioisotope therapy apparatus and to assist medical officers in radioisotope therapy.

Instruction: Lectures on mathematics, general chemistry, nuclear physics, radiation safety, radiochemistry, clinical practice, and laboratory procedures.

Credit Recommendation: Version 1: In the vocational certificate category, 3 semester hours in algebra, 6 in physics, 6 in physiology, and 3 in hematology (7/74); in the lower-division baccalaureate/associate degree category, 3 semester hours in algebra, 6 in physics, 6 in physiology, and 3 in hematology (7/74). Version 2: In the vocational certificate category, 4 semester hours in general chemistry, 3 in mathematics, 8 in radioisotope technology, 4 in physical science, and additional credit in radioisotope technology on the basis of institutional examination (2/74); in the lower-division baccalaureate/associate degree category, 4 semester hours in general chemistry, 3 in mathematics, 8 in radioisotope technology, 4 in physical science, and additional credit in radioisotope technology on the basis of institutional examination (2/74); in the upper-division baccalaureate category, 3 semester hours in general chemistry (12/68).